Beaver Dam and Loon Lakes Aquatic Plant Management Plan Revision 2007
Excerpt from Yellow Creek Lakes Diagnostic Study
Kosciusko County, Indiana

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Introduction

Beaver Dam and Loon lakes' aquatic plant communities were assessed as part of the diagnostic study on August 28, 2007. Survey results indicate that both lakes contain relatively sparse aquatic plant communities with the community present in Beaver Dam Lake being more diverse than that present in Loon Lake. Generally, poor water clarity limits the aquatic plant community present in Loon Lake, while Beaver Dam Lake's plant community is limited by sharp drop-offs, rocky substrate, and limited water clarity. Overall, exotic species are not a problem within either lake at this time (2007). Nonetheless, spot treatment of exotic species and education of lakeshore property owners and lake users on the impacts of exotic, invasive aquatic species should be considered in the future The following sections detail specifics of the aquatic plant survey, provide recommendations for future actions, and identify costs associated with these efforts.

Macrophyte Assessment Methods

JFNew surveyed Beaver Dam and Loon lakes' plant communities on August 28, 2007 according to the Indiana Department of Natural Resources (IDNR) sampling protocols (IDNR, 2007). The survey included two components: 1) a general survey to identify aquatic plants present in the lakes and to map exotic species locations within the lakes and 2) a Tier II survey, which requires sampling at specific points throughout the lakes' littoral zones.

In order to create exotic species maps, JFNew examined the entire littoral zone of the lakes. A survey crew, consisting of one aquatic ecologist, one technician, and a citizen volunteer boat driver, surveyed the lakes in a clockwise manner. The survey crew drove their boat in a zig-zag pattern across the littoral zone of the lake while visually identifying plant species. The crew maintained a tight pattern to ensure the entire zone was observed. Additionally, in areas of dense plant coverage, rake grabs were performed to ensure all species were identified. All identified species were recorded; all exotic species locations were mapped on an aerial photograph.

The Tier II survey protocol is designed to develop a quantitative estimate of the density and diversity of all submerged aquatic species within each lake. The survey protocol requires that a specific number of sampling locations occur within each lake. Additionally, the sampling points are stratified over the entire depth of the lake's littoral zone as defined by the Tier II protocol (IDNR, 2007). Total points sampled per stratum were determined as follows:

1. Appendix D of the survey protocol was consulted to determine the number of points to be sampled and the maximum sampling depth. This determination was based on the lake size (surface area) and trophic status.
2. Table 3 of the survey protocol was referenced as an indicator of the number of sample points per stratum. Table A in this report lists the sampling strategy for Beaver Dam and Loon lakes while Figures A and B display the points sampled during each lake's survey.

Stratum refers to the depth at which plants were observed. Dominance presented in subsequent tables was calculated by the IDNR protocol. The frequency per species presented in subsequent tables provides a measure of the frequency of a species sampled in each stratum.

Table A. Tier II sampling strategy for Beaver Dam and Loon lakes using the 2007 Tier II protocol.

Lake	Size	Trophic Status	Number of Points	Stratification of Points
Beaver Dam Lake	146 acres	Hypereutrophic	50	40 pts 0-5 foot stratum 10 pts 5-10 foot stratum
Loon Lake	40 acres	Eutrophic	30	10 pts 0-5 foot stratum 10 pts 5-10 foot stratum 10 pts 10-15 foot stratum

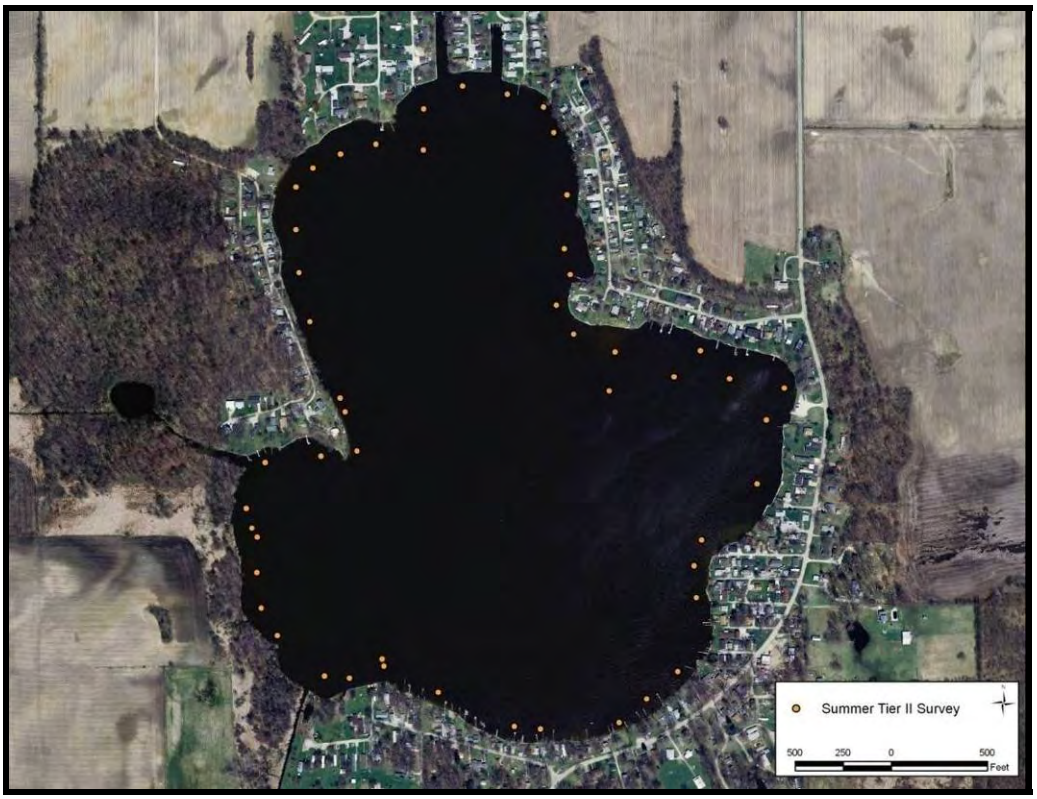

Figure A. Points sampled during the Tier II aquatic plant assessment of Beaver Dam Lake.

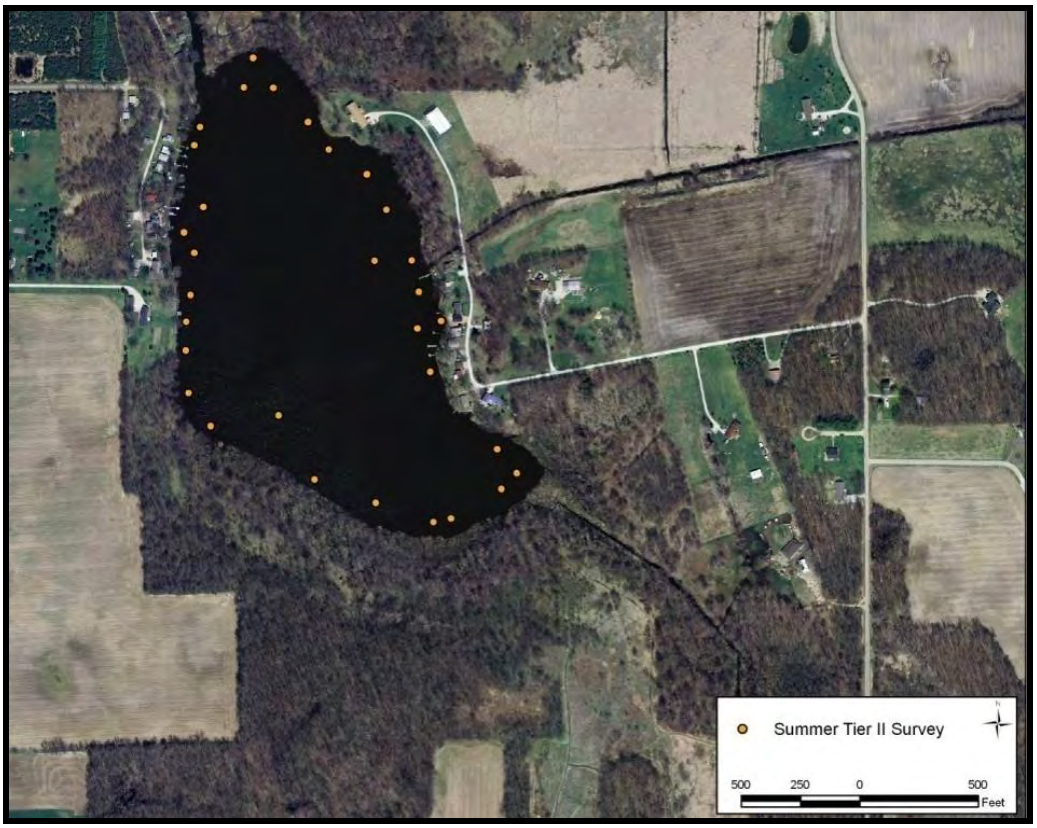

Figure B. Points sampled during the Tier II aquatic plant assessment of Loon Lake.

The data from the surveys are used to calculate different lake characteristics and community and species metrics. The different characteristics and metrics calculated from the Tier II method are defined below:

- Littoral depth: Maximum depth that aquatic vegetation is present.
- Total sites: Total number of sites sampled.
- Littoral sites: Number of sites within the littoral depth.
- Secchi depth: Measurement of the transparency of water.
- Species richness: count of all submersed plant species collected.
- Native species richness: count of all native submersed plant species collected.
- Maximum number of species per site: highest number of species collected at any site.
- Mean number of species per site: The average number of all species collected per site.
- Mean number of native species per site: The average number of native species per site.
- Species diversity index: Modified Simpson's diversity index—a measure that provides a means of comparing plant community structure and stability over time.
- Frequency of occurrence: Measurement of the percentage of sampled sites where each species is present.
- Relative frequency of occurrence: Measures the distribution of plants occurrence throughout the lake in relation to each other.
- Dominance index: Combines the frequency of occurrence and relative density into a dominance value. This value characterizes how dominant a species is within the aquatic plant community (IDNR, 2007).

Macrophyte Inventory and Tier II Results
Beaver Dam Lake

Inventory

Transparency was found to be 4.5 feet in Beaver Dam Lake during the Tier II survey. Beaver Dam Lake supports a modest rooted aquatic plant community. The community extends from the lake's shoreline to water that is just over 8 feet (2.4 m) deep. In total, 26 aquatic plant species inhabit the water and shoreline of Beaver Dam Lake (Table B). The LARE protocol used to conduct the aquatic plant survey requires surveyors to note all plant species observed from a boat. Thus, plants in the wetland complexes adjacent to the lake were only counted if they were visible from the boat. If these wetland complexes had been explored in greater detail, it is likely that the total number of plant species would increase significantly.

Of the 26 species observed in Beaver Dam Lake, thirteen were submerged plant species. Of the thirteen submerged species, nearly all of those are adapted to high nutrient environments. Six of the submerged species were pondweeds (i.e. belonging to the *Potamogeton* genus), which are typically adapted to better water quality conditions. However, most of these species were identified in relatively low density. Sago pondweed, musk grass, and coontail dominated the submerged plant community and were observed throughout the lake. Three exotic species, including Eurasian watermilfoil, purple loosestrife, and reed canary grass, were identified within or adjacent to Beaver Dam Lake.

The species richness of the emergent strata was a bit lower than the submerged strata, while the floating strata's richness was much lower than the emergent and submerged strata. Nine (9) emergent species were noted bordering Beaver Dam Lake's edges, while only three floating species were observed in the lake. (It is important to note that there are significantly fewer floating aquatic species that are native to Indiana lakes compared to the number of emergent and submerged species. Consequently, many lakes possess low numbers of floating species.) The most common emergent species include purple loosestrife and reed canary grass. The most common floating species are spatterdock and duckweed.

Table B. Plant species observed in Beaver Dam Lake as identified on August 28, 2007.

Scientific Name	Common Name	Stratum
Ceratophyllum demersum	Coontail	Submergent
Chara species	Musk grass species	Submergent
Decodon verticillatus	Whirled loosestrife	Emergent
Filamentous algae	Filamentous algae	Algae
Heteranthera dubia	Water star grass	Submergent
Lythrum salicaria	Purple loosestrife	Emergent
Myriophyllum spicatum	Eurasian watermilfoil	Submergent
Najas flexilis	Slender naiad	Submergent
Najas guadalupensis	Southern naiad	Submergent
Nuphar advena	Spatterdock	Floating
Nuphar variegatum	Yellow pond lily	Floating
Nymphaea tuberosa	White water lily	Floating
Phalarus arundinacaea	Reed canary grass	Emergent
Polygonum hydropiperoides	Swamp smartweed	Emergent

Polygonum lapathifolium	Willow-weed	Emergent
Potamogeton berchtoldii	Broad-leaf small pondweed	Submergent
Potamogeton foliosis	Leafy pondweed	Submergent
Potamogeton gramineus	Grassy pondweed	Submergent
Potamogeton illinoensis	Illinois pondweed	Submergent
Potamogeton nodosus	Long-leaf pondweed	Submergent
Scirpus pungens	Chairmaker's rush	Emergent
Stuckenia pectinatus	Sago pondweed	Submergent
Typha angustifolia	Narrow-leaf cattail	Emergent
Typha x *glauca*	Blue cattail	Emergent
Typha latifolia	Broad-leaf cattail	Emergent
Vallisneria americana	Eel grass	Submergent

Tier II

During the Tier II survey, sago pondweed dominated the plant community over all depths (0-10 feet; Table C). (Appendix A details raw data collected during the Tier II aquatic plant survey.) This species was found at the highest percentage of sites throughout the water column (32%) and also had the highest relative density (0.8). Throughout the entire sampled water column, other species were somewhat frequent with musk grass present at 18% of the sites and coontail present at 14% of the sites. With regards to density, sago pondweed dominated the submerged plant community throughout the entire sampled water column with a dominance of 16. (A dominance of 250 represents a perfect score or the highest dominance possible within Beaver Dam Lake. This results from multiplying the highest density score (5) by the number of sites where plants were sampled (50). Dominance scores are reported as percentages of this maximum.) All other species were relatively sparse throughout the entire sampled water column, with coontail possessing a dominance of 6, long-leaf pondweed a dominance of 4.4, musk grass a dominance of 3.6, and southern naiad a dominance of 2.0. All other species had dominances less than 2. Filamentous algae were also present at 40% of the sites; however, densities are not assigned to this species. Maps detailing other species locations are included in Appendix B.

Table C. Frequency and dominance of submerged aquatic plant species identified during the Tier II survey of Beaver Dam Lake conducted August 28, 2007.

Occurrence and abundance of submersed aquatic plants in Beaver Dam Lake.					
Total Sites:	50	Mean species / site:	1.08	Native diversity:	0.84
Littoral Sites:	47	Maximum species / site:	5	Species diversity:	0.84
Littoral Depth (ft):	8	Number of species:	13	SE Mean natives / site:	0.17
Date:	8/28/07	Littoral sites with plants:	29	Mean natives / site:	1.06
Lake:	Beaver Dam	Secchi(ft):	4.5	SE Mean species / site:	0.18

All depths (0-10')		**Frequency of Occurrence**	**Frequency per Species**				
Scientific Name	**Common Name**		**0**	**1**	**3**	**5**	**Dominance**
Stuckenia pectinatus	Sago pondweed	32.00	68.00	14.00	12.00	6.00	16.00
Chara species	Chara species	18.00	82.00	18.00	0.00	0.00	3.60
Ceratophyllum demersum	Coontail	14.00	86.00	6.00	8.00	0.00	6.00
Najas guadalupensis	Southern naiad	10.00	90.00	10.00	0.00	0.00	2.00
Potamogeton nodosus	Long-leaf pondweed	10.00	90.00	6.00	2.00	2.00	4.40
Potamogeton berchtoldii	Broad-leaf small pondweed	6.00	94.00	6.00	0.00	0.00	1.20
Potamogeton gramineus	Grassy pondweed	4.00	96.00	4.00	0.00	0.00	0.80

Potamogeton foliosis	Leafy pondweed	4.00	96.00	4.00	0.00	0.00	0.80
Myriophyllum spicatum	Eurasian watermilfoil	2.00	98.00	2.00	0.00	0.00	0.40
Potamogeton illinoensis	Illinois pondweed	2.00	98.00	2.00	0.00	0.00	0.40
Najas flexilis	Slender naiad	2.00	98.00	2.00	0.00	0.00	0.40
Heteranthera dubia	Water star grass	2.00	98.00	2.00	0.00	0.00	0.40
Vallisneria americana	Eel grass	2.00	98.00	0.00	2.00	0.00	1.20
Filamentous algae	Filamentous algae	40.00					

0-5' Stratum		**Frequency of Occurrence**	**Frequency per Species**				
Scientific Name	**Common Name**		**0**	**1**	**3**	**5**	**Dominance**
Stuckenia pectinatus	Sago pondweed	40.00	60.00	17.50	15.00	7.50	20.00
Chara species	Chara species	20.00	80.00	20.00	0.00	0.00	4.00
Ceratophyllum demersum	Coontail	17.50	82.50	7.50	10.00	0.00	7.50
Potamogeton nodosus	Long-leaf pondweed	12.50	87.50	7.50	2.50	2.50	5.50
Najas guadalupensis	Southern naiad	10.00	90.00	10.00	0.00	0.00	2.00
Potamogeton berchtoldii	Broad-leaf small pondweed	7.50	92.50	7.50	0.00	0.00	1.50
Potamogeton gramineus	Grassy pondweed	5.00	95.00	5.00	0.00	0.00	1.00
Potamogeton foliosis	Leafy pondweed	5.00	95.00	5.00	0.00	0.00	1.00
Myriophyllum spicatum	Eurasian watermilfoil	2.50	97.50	2.50	0.00	0.00	0.50
Potamogeton illinoensis	Illinois pondweed	2.50	97.50	2.50	0.00	0.00	0.50
Najas flexilis	Slender naiad	2.50	97.50	2.50	0.00	0.00	0.50
Heteranthera dubia	Water star grass	2.50	97.50	2.50	0.00	0.00	0.50
Vallisneria americana	Eel grass	2.50	97.50	0.00	2.50	0.00	1.50
Filamentous algae	Filamentous algae	37.50					

5-10' Stratum		**Frequency of Occurrence**	**Frequency per Species**				
Scientific Name	**Common Name**		**0**	**1**	**3**	**5**	**Dominance**
Najas guadalupensis	Southern naiad	10.00	90.00	10.00	0.00	0.00	2.00
Chara species	Chara species	10.00	90.00	10.00	0.00	0.00	2.00
Filamentous algae	Filamentous algae	50.00					

Sago pondweed also dominated the submerged plant community in the 0-5 foot stratum (Table X). Sago pondweed was the most frequent species as it was found at nearly 40% of the sites in the 0-5 foot stratum. Sago pondweed generated the highest dominance rating (20) in the 0-5 foot stratum. In this same stratum, musk grass was identified at 20% of the sites, but was relatively sparse scoring a dominance of 4.0. Coontail was found at 17.5% of the sites in the 0-5 foot stratum and possessed a dominance of 7.5. Long-leaf pondweed was found at only 12.5% of the sites in the 0-5 foot stratum, but possessed a dominance of 5.5. All other species were relatively infrequent occurring at less than 12.5% of the sites and possessing dominances of 2.0 or less (Table X). Southern naiad and musk grass were the only plant species identified in the 5-10 foot stratum. Each species were found at 10% of the sites and measured a dominance of 2.0 in the 5-10 foot stratum. Filamentous algae were found at 50% of the sites in the 5-10 foot stratum. As previously mentioned, one exotic submerged species were identified within Beaver Dam Lake during the Tier II assessment. Eurasian watermilfoil was identified at 2% of the sites throughout the lake (Figure X).

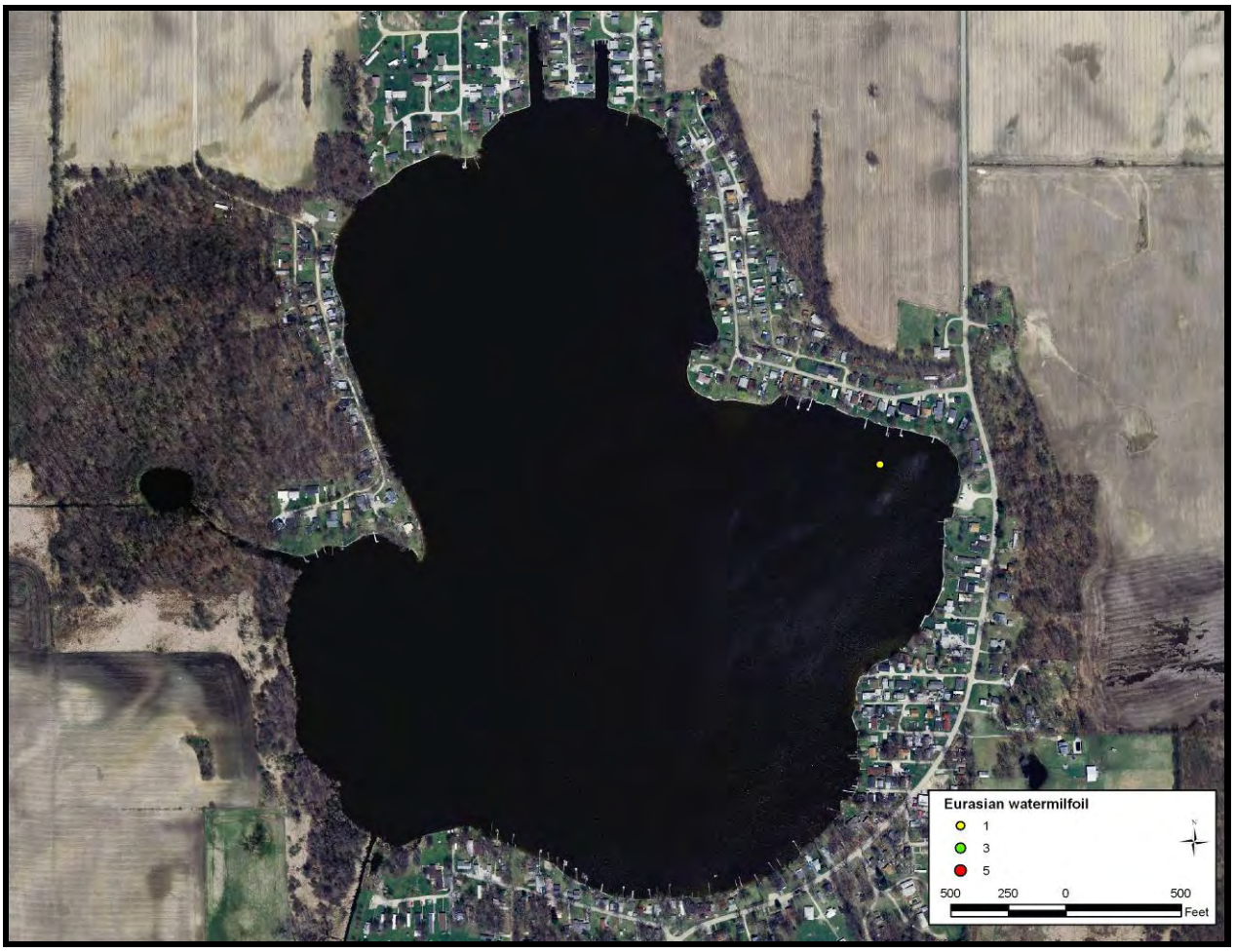

Figure C. Location and density of Eurasian watermilfoil identified in Beaver Dam Lake during the August 28, 2007 Tier II survey.

Plant Management History

On October 10, 2007, Weed Patrol Inc. treated a total of 4 acres of Eurasian watermilfoil. Treatment occurred during sunny conditions (approximately 70ºF) with a light wind. Figure D indicates the specific locations, plant species targeted, and size of area targeted during the aforementioned herbicide application. In total, 4 acres of Eurasian watermilfoil were treated in 2007. For selective Eurasian watermilfoil control, roughly 2 ppm of Aquathol K (approximately 1 gallon per acre depending on the depth and size of the area) was applied. On June 2, 2004, Weed Patrol, Inc. treated a total of 35 acres of filamentous algae, chara, curly-leaf pondweed, and Eurasian watermilfoil. For curly-leaf pondweed control, 1.0 mg/L of Aquathol K herbicide was used (applied at a rate of approximately 1 gallon per acre). This low rate was used to control curly-leaf pondweed, which is more sensitive to Aquathol K, while not killing native pondweeds (Tony Cunningham, Weed Patrol, personal communication). For all treatments, herbicide was applied by making narrow passes through the treatment area. Filamentous algae were treated with copper sulfate at a rate of 2.6 lb/acre-foot. On May 27, 2005, Weed Patrol, Inc. completed a whole-lake treatment on Beaver Dam Lake targeting filamentous algae, chara, curly-leaf pondweed, and Eurasian watermilfoil.

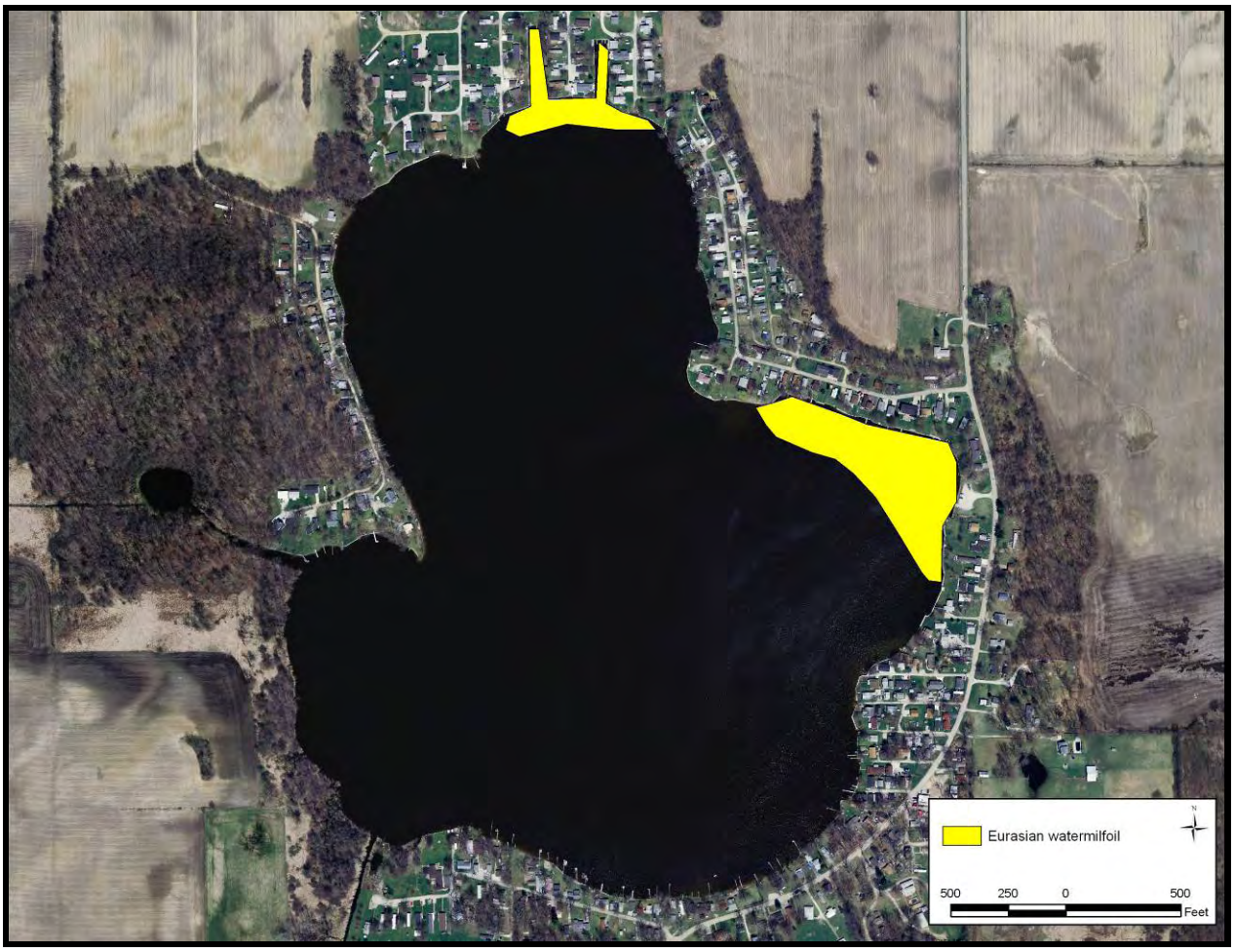

Figure D. Eurasian watermilfoil treatment area located on Beaver Dam Lake. Weed Patrol completed treatment on October 10, 2007.

Loon Lake

Inventory

Transparency was found to be 4.5 feet in Loon Lake during the Tier II survey. Loon Lake supports a modest aquatic plant community. The community extends from the lake's shoreline to water that is 7 feet (2.1 m) deep. In total, 22 aquatic plant species inhabit the water and shoreline of Loon Lake (Table D). The LARE protocol used to conduct the aquatic plant survey requires surveyors to note all plant species observed from a boat. Thus, plants in the wetland complexes adjacent to the lake were only counted if they were visible from the boat. If these wetland complexes had been explored in greater detail, it is likely that the total number of plant species would increase significantly.

Table D. Plant species observed in Loon Lake as identified on August 28, 2007.

Scientific Name	Common Name	Stratum
Asclepias incarnata	Swamp milkweed	Emergent
Ceratophyllum demersum	Coontail	Submergent
Chara species	Musk grass species	Submergent
Decodon verticillatus	Whirled loosestrife	Emergent

Filamentous algae	Filamentous algae	Algae
Iris virginica	Blue-flag iris	Emergent
Myriophyllum exalbescens	Northern watermilfoil	Submergent
Myriophyllum spicatum	Eurasian watermilfoil	Submergent
Najas guadalupensis	Southern naiad	Submergent
Nuphar advena	Spatterdock	Floating
Nuphar variegatum	Yellow pond lily	Floating
Nymphaea tuberosa	White water lily	Floating
Pontederia cordata	Pickerel weed	Emergent
Potamogeton berchtoldii	Broad-leaf small pondweed	Submergent
Sagittaria latifolia	Common arrowhead	Emergent
Scirpus acutus	Hard-stem bulrush	Emergent
Scirpus fluviatilis	River bulrush	Emergent
Scirpus pungens	Chairmaker's rush	Emergent
Sparganium eurycarpum	Giant burreed	Emergent
Typha angustifolia	Narrow-leaf cattail	Emergent
Typha x *glauca*	Blue cattail	Emergent
Typha latifolia	Broad-leaf cattail	Emergent

Of the 22 species observed in Loon Lake, six species were submerged plant species. Of the six submerged species, nearly all of those are adapted to high nutrient environments. Two species, northern watermilfoil and broad-leaf small pondweed, are typically indicative of relatively good water quality. However, both species were identified in relatively low density. Compared to other lakes in the region, this diversity of submerged species represents relatively low species richness for the submerged strata. Coontail dominated the submerged plant community and was observed throughout the lake. One exotic species, Eurasian watermilfoil, was identified within or adjacent to Loon Lake.

The species richness of the emergent strata was much higher than the submerged strata, while the floating strata's richness was much lower than the emergent and submerged strata. Twelve (12) emergent species were noted bordering Loon Lake's edges, while only three floating species were observed in the lake. (It is important to note that there are significantly fewer floating aquatic species that are native to Indiana lakes compared to the number of emergent and submerged species. Consequently, many lakes possess low numbers of floating species.) The most common emergent species include reed canary grass, whirled loosestrife, and cattails, including narrow-leaf, broad-leaf, and blue cattail. The most common floating species are spatterdock, white water lily, and duckweed.

Tier II

During the survey, coontail dominated the plant community over all depths (0-15 feet; Table E). (Appendix A details raw data collected during the Tier II aquatic plant survey.) This species was found at the highest percentage of sites throughout the entire sampled water column (58%) and also had the highest mean (2.33) and relative densities (1.35). Throughout the entire sampled water

column, no other species were relatively frequent. Eurasian watermilfoil was present at 6.5% of the sites throughout the entire sampled water column. Broad-leaf small pondweed, southern naiad, northern watermilfoil, and musk grass were each found at 3.2% of the sites. With regards to dominance, coontail dominated the submerged plant community throughout the entire sampled water column with a dominance of 27.1. (A dominance of 150 represents a perfect score or the highest dominance possible within Loon Lake. This results from multiplying the highest density score (5) by the number of sites where plants were sampled (30). Dominance scores are reported as percentages of this maximum.) Eurasian watermilfoil recorded a dominance of 1.3. All other species had dominances less than 1. Filamentous algae were also present at 87% of the sites; however, densities are not assigned to this species. Maps detailing other species locations are included in Appendix B.

Table E. Frequency and dominance of submerged aquatic plant species identified during the Tier II survey of Loon Lake conducted August 28, 2007.

Occurrence and abundance of submersed aquatic plants in Loon Lake.					
Total Sites:	31	Mean species / site:	0.77	Native diversity:	0.32
Littoral Sites:	22	Maximum species / site:	5	Species diversity:	0.42
Littoral Depth (ft):	7	Number of species:	6	SE Mean natives / site:	0.15
Date:	8/28/07	Littoral sites with plants:	18	Mean natives / site:	0.71
Lake:	Loon	Secchi(ft):	4.5	SE Mean species / site:	0.18

All depths (0-15')		**Frequency of Occurrence**	**Frequency per Species**				
Scientific Name	**Common Name**		**0**	**1**	**3**	**5**	**Dominance**
Ceratophyllum demersum	Coontail	58.06	41.94	25.81	25.81	6.45	27.10
Myriophyllum spicatum	Eurasian watermilfoil	6.45	93.55	6.45	0.00	0.00	1.29
Potamogeton berchtoldii	Broad-leaf small pondweed	3.23	96.77	3.23	0.00	0.00	0.65
Najas guadalupensis	Southern naiad	3.23	96.77	3.23	0.00	0.00	0.65
Myriophyllum exalbescens	Northern water milfoil	3.23	96.77	3.23	0.00	0.00	0.65
Chara species	Chara species	3.23	96.77	3.23	0.00	0.00	0.65
Filamentous algae	Filamentous algae	87.10					
0-5' Stratum		**Frequency of Occurrence**	**Frequency per Species**				
Scientific Name	**Common Name**		**0**	**1**	**3**	**5**	**Dominance**
Ceratophyllum demersum	Coontail	92.86	7.14	28.57	50.00	14.29	50.00
Myriophyllum spicatum	Eurasian watermilfoil	14.29	85.71	14.29	0.00	0.00	2.86
Potamogeton berchtoldii	Broad-leaf small pondweed	7.14	92.86	7.14	0.00	0.00	1.43
Najas guadalupensis	Southern naiad	7.14	92.86	7.14	0.00	0.00	1.43
Myriophyllum exalbescens	Northern water milfoil	7.14	92.86	7.14	0.00	0.00	1.43
Chara species	Chara species	7.14	92.86	7.14	0.00	0.00	1.43
Filamentous algae	Filamentous algae	92.86					
5-10' Stratum		**Frequency of Occurrence**	**Frequency per Species**				
Scientific Name	**Common Name**		**0**	**1**	**3**	**5**	**Dominance**
Ceratophyllum demersum	Coontail	38.46	61.54	30.77	7.69	0.00	10.77
Filamentous algae	Filamentous algae	76.92					
10-15' Stratum		**Frequency of Occurrence**	**Frequency per Species**				
Scientific Name	**Common Name**		**0**	**1**	**3**	**5**	**Dominance**
Filamentous algae	Filamentous algae	100.00					

Coontail also dominated the submerged plant community in the 0-5 foot and 5-10 foot strata (Table E). Coontail was the most frequent species as it was found at 93% of the sites in the 0-5 foot

stratum and at 38.5% of the sites in the 5-10 foot stratum. Coontail generated the highest dominance rating of 50 and 10.8 in the 0-5 foot and 5-10 foot strata, respectively. Eurasian watermilfoil had a relatively low frequency (14.3) and dominance (2.9) in the 0-5 foot stratum. Eurasian watermilfoil was not identified in the 5-10 foot or the 10-15 foot strata of Loon Lake. Overall, Eurasian watermilfoil was identified at 6.5% of the sites throughout the lake (Figure E).

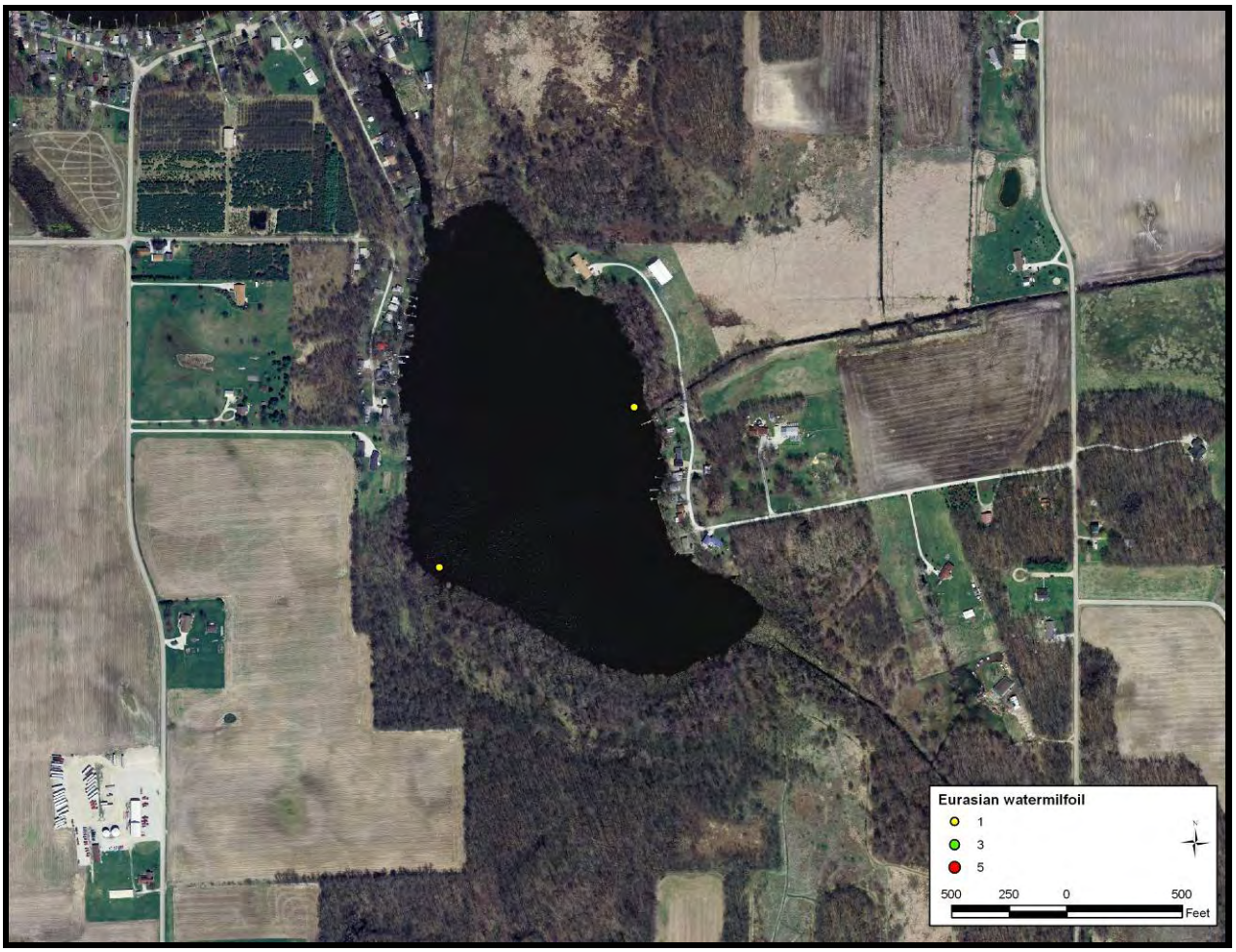

Figure E. Location and density of Eurasian watermilfoil identified in Loon Lake during the August 28, 2007 Tier II survey.

Plant Management History

On September 9, 2005, Weed Patrol Inc. treated a total of 8 acres of Eurasian watermilfoil. Treatment occurred during sunny conditions (approximately 70ºF) with a light wind. In total, 8 acres of Eurasian watermilfoil were treated in 2005. For selective Eurasian watermilfoil control, roughly 2 ppm of Aquathol K (approximately 1 gallon per acre depending on the depth and size of the area) was applied.

Current and Historic Data Comparison

When recently collected data is compared with data reported by Pearson (2004), in general Beaver Dam Lake possesses greater diversity than the lakes surveyed by Pearson (Table F). Beaver Dam Lake possessed higher numbers of native species and numbers of species overall during the summer survey than those identified on average in Pearson's study. Beaver Dam Lake also possessed greater

rake diversity, greater native rake diversity, and greater native and overall species richness during the 2007 survey than those recorded during Pearson's survey. Data suggest that the plant community observed in Beaver Dam Lake during the August 2007 survey is the highest quality community observed within the lake over the past 2 years.

Table F. A comparison of the pre- and post-treatment aquatic plant communities in Beaver Dam Lake to the average values for plant community metrics found by Pearson (2004) in his survey of 21 northern Indiana lakes. Bolding indicates that the value exceeds Pearson average.

Metric	8/10 2004	5/9 2005	8/7 2005	5/23 2005	7/25 2005	8/28 2007	Indiana Average
Number of species collected	5	2	2	5	3	**13**	8
Number of native species	4	1	2	4	3	**12**	7
Species Richness	**1.6**	0	**0.8**	0.40	0.20	**0.84**	0.66
Native Species Richness	**1.7**	**0.8**	0.49	0.10	0.20	**0.84**	0.56
Rake Diversity	**1.2**	**1.2**	0.49	0.05	0.02	**1.08**	0.62
Native Rake Diversity	**0.6**	0.35	0.49	0.01	0.02	**1.06**	0.5

Sources: Weed Patrol, 2004; Weed Patrol, 2005; IDNR, 2006.

When recently collected data is compared with data reported by Pearson (2004), in general Loon Lake possesses poorer diversity than the lakes surveyed by Pearson (Table G). Loon Lake possessed lower numbers of native species, numbers of species overall, species richness, and native species richness during the 2007 survey than those identified on average in Pearson's study. Loon Lake possessed greater rake and native rake diversity during the 2007 survey than those recorded during Pearson's survey.

Table G. A comparison of the pre- and post-treatment aquatic plant communities in Loon Lake to the average values for plant community metrics found by Pearson (2004) in his survey of 21 northern Indiana lakes. Bolding indicates that the value exceeds Pearson average.

Metric	8/10 2004	5/9 2005	8/7 2005	5/22 2006	7/24 2006	8/28 2007	Indiana Average
Number of species collected	2	3	2	3	1	6	8
Number of native species	1	2	2	3	1	5	7
Species Richness	**2.3**	**2.55**	**1.79**	0.26	0	0.42	0.66
Native Species Richness	**2.4**	**0.82**	**1.84**	0.26	0	0.32	0.56
Rake Diversity	**1.3**	**1.45**	**0.74**	0.47	0.43	**0.77**	0.62
Native Rake Diversity	**1.0**	**0.64**	**0.74**	0.47	0.43	**0.71**	0.5

Sources: Weed Patrol, 2005; IDNR, 2006.

Macrophyte Inventory Discussion

Since we cannot account for all the spatial variables impacting the plant community, such as boat-traffic and changes in nutrient availability, or for temporal variables, like climactic conditions, including temperature and precipitation levels, an exact and precise analysis regarding the impact of herbicide treatment upon Beaver Dam and Loon Lakes aquatic plant community is not possible. Still, general trends emerge from the data that are useful for the purpose of management decisions.

When comparing data for Eurasian watermilfoil, site frequencies, mean and relative densities, and dominance, no clear pattern can be determined. When the 2004 and 2007 data are compared, no significant changes in summer Eurasian watermilfoil frequencies were observed in Beaver Dam Lake. Given its relatively low density and frequency, it is not surprising that Eurasian watermilfoil was not observed by Weed Patrol, Inc. and the IDNR during the summer surveys in 2005 (Table H).

However, spring data suggest that Eurasian watermilfoil is relatively dense during the spring and that treatment is assisting in reducing this species' density and frequency on an annual basis. In Loon Lake, similar variations occur on an annual basis and over time during each season. However, no pattern is apparent at this time.

Table H. Variation in site frequency, relative and mean density, and dominance of Eurasian watermilfoil in Beaver Dam and Loon Lakes from 2004 to 2007.

Common Name	Date	Site Frequency	Relative Density	Mean Density	Dominance
Beaver Dam Lake	8/10/04	0.6	0.7	0.0	--
	5/9/05	38.6	1.5	1.8	--
	5/23/05	30.0	0.4	1.2	7.0
	7/25/05	0.0	0.0	0.0	0.0
	8/7/05	0.0	0.0	0.0	0.0
	8/28/07	2.0	0.02	1.0	0.4
Loon Lake	8/10/04	28.6	0.3	1.0	--
	5/9/05	50.0	1.8	2.2	--
	8/7/05	0.0	0.0	0.0	0.0
	5/22/06	0.0	0.0	0.0	0.0
	7/24/06	0.0	0.0	0.0	0.0
	8/28/07	6.5	0.06	1.0	1.3

Sources: Weed Patrol, 2004; Weed Patrol, 2005; IDNR, 2006. – indicates no data is available

It is difficult to determine how the native aquatic plant communities within Beaver Dam and Loon Lakes are responding to herbicide treatment as only six data sets spanning three growing seasons have been reported. Furthermore, these data sets are separated by one growing season each. A more complete data set should allow for better determination of the plant community's response to treatment methodologies in Beaver Dam and Loon Lakes.

Recommendations

Based on the 2007 survey JFNew completed and the permit meeting held by the IDNR on November 9, 2007, treatment recommendations for 2008 in Beaver Dam Lake should include the herbicide application for Eurasian watermilfoil. This is in line with the goals expresses by the Beaver Dam and Loon Lake Conservation Club president. As Eurasian watermilfoil density remains relatively low in Beaver Dam Lake, it is likely that spot treatment outside of the LARE program may be the most cost effective methodology for controlling Eurasian watermilfoil. If it control of Eurasian watermilfoil continues to be a priority, then approximately 5 acres of Eurasian watermilfoil in Beaver Dam Lake should be treated using 2,4-D. It is recommended that no treatment occur within Loon Lake in 2008. Additionally, as these lakes do not currently possess an approved aquatic plant management plan, it is required that the conservation club complete a revised aquatic plant management plan in order to be eligible for continued funding through the LARE program. The

completion of this modified plan revision as part of the Yellow Creek Lakes Diagnostic Study qualifies the association for 2008 funding.

Project Budget

Costs for aquatic plant assessment and treatment in 2008 are as follows:

- Eurasian watermilfoil treatment of approximately 5 acres with granular 2,4-D at a cost of $375 per acre for a total cost of $1,875.
- Standard LARE assessment, public meeting, and plan revision costs are based on 2007 LARE requirements (pre-treatment exotic species distribution survey; one post-treatment Tier II survey; public meeting; plan revision). Assessment of Beaver Dam Lake's plant community and plan revision is anticipated to occur at a cost of $8,000.

Total fees for 2008 aquatic plant assessment, herbicide application, and plan revision are estimated at $9,875. LARE has historically provided funding of up to $20,000 for aquatic plant treatment and provides monies for surveys and plan revisions. All of these monies require a 10% match.

The following time schedule is anticipated for aquatic plant management activities for Beaver Dam and Loon Lakes in 2008:

May 15-June 15, 2008	Pre-treatment/spring Tier II survey; Approximate Eurasian watermilfoil treatment
July 15-August 30, 2008	Tier II post-treatment/summer assessment
August-October, 2008	Public meeting
November 2008	Meeting between IDNR LARE and fisheries staff, lake associations, and contractor
December 15, 2008	Plan revision and permit
January 15, 2009	LARE application for 2009 funding due

References Cited

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Pearson, J. 2004. A sampling method to assess occurrence, abundance and distribution of submersed aquatic plants in Indiana lakes. Indiana Department of Natural Resources, Division of Fish and Wildlife, Indianapolis, Indiana.

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APPENDIX A:

TIER II SURVEY RAW DATA

BEAVER DAM AND LOON LAKES
AQUATIC PLANT MANAGEMENT PLAN REVISION 2007
EXCERPT FROM YELLOW CREEK LAKES DIAGNOSTIC STUDY

LAKE	DEPTH	FILALG	CERDEM	CHARA	HETDUB	MYRSPI	NAJFLE	NAJGUA	POTBER	POTFOL	POTGRA	POTILL	POTNOD	POTPEC	VALAME	X_COOR	Y_COOR
Beaver Dam	8	p														585685.3388	4549987.497
Beaver Dam	5															585686.2158	4549920.118
Beaver Dam	10															585692.2811	4549851.715
Beaver Dam	5															585710.957	4549774.688
Beaver Dam	5															585760.3127	4549654.192
Beaver Dam	3															585768.9937	4549632.638
Beaver Dam	3															585788.7174	4549571.002
Beaver Dam	5	p	3													585731.4716	4549561.894
Beaver Dam	4	p	1													585643.0973	4549550.557
Beaver Dam	4	p	1													585614.3269	4549477.539
Beaver Dam	5	p														585624.1768	4549446.246
Beaver Dam	9	p														585632.1584	4549431.852
Beaver Dam	5	p														585632.6739	4549376.212
Beaver Dam	4															585640.5373	4549319.777
Beaver Dam	3		3	1												585666.5088	4549276.739
Beaver Dam	5	p	3													585742.2461	4549213.655
Beaver Dam	3	p	3													585782.2935	4549210.825
Beaver Dam	7															585833.5687	4549241.981
Beaver Dam	3															585836.5833	4549230.881
Beaver Dam	3													1		585923.0355	4549190.592
Beaver Dam	5												3			586044.8374	4549138.4
Beaver Dam	4	p							1		1			1		586085.8389	4549135.164
Beaver Dam	2	p												1		586210.5195	4549147.257
Beaver Dam	4												1	5		586253.9895	4549184.729
Beaver Dam	2	p	1	1							1			3		586302.6401	4549229.242
Beaver Dam	4														3	586329.958	4549346.626
Beaver Dam	5			1										3		586325.5924	4549397.16
Beaver Dam	3			1						1				5		586336.8393	4549438.203
Beaver Dam	4								1					5		586423.3323	4549528.504
Beaver Dam	4	p												1		586436.3541	4549629.887
Beaver Dam	4	p		1	1			1					1	1		586464.1346	4549681.074
Beaver Dam	4					1			1					3		586377.2461	4549694.173
Beaver Dam	3													3		586330.2087	4549738.036
Beaver Dam	8			1												586289.2494	4549695.764
Beaver Dam	5												5			586187.0898	4549672.079
Beaver Dam	2			1										3		586194.9463	4549734.008
Beaver Dam	3									1		1	1	1		586129.0169	4549760.92
Beaver Dam	2													1		586101.3126	4549806.744
Beaver Dam	3															586122.2345	4549855.221
Beaver Dam	8															586112.4333	4549896.238
Beaver Dam	7	p														586115.0612	4549981.802
Beaver Dam	8	p						1								586092.744	4550080.025
Beaver Dam	4			1				1						3		586018.1245	4550139.736
Beaver Dam	3						1	1								586076.1519	4550120.172
Beaver Dam	4	p		1				1								585946.8504	4550151.658
Beaver Dam	5	p														585885.9972	4550114.163
Beaver Dam	5	p														585811.1125	4550057.579
Beaver Dam	9															585886.3168	4550049.406
Beaver Dam	6	p														585755.0435	4550040.762
Beaver Dam	4															585711.8645	4550017.928

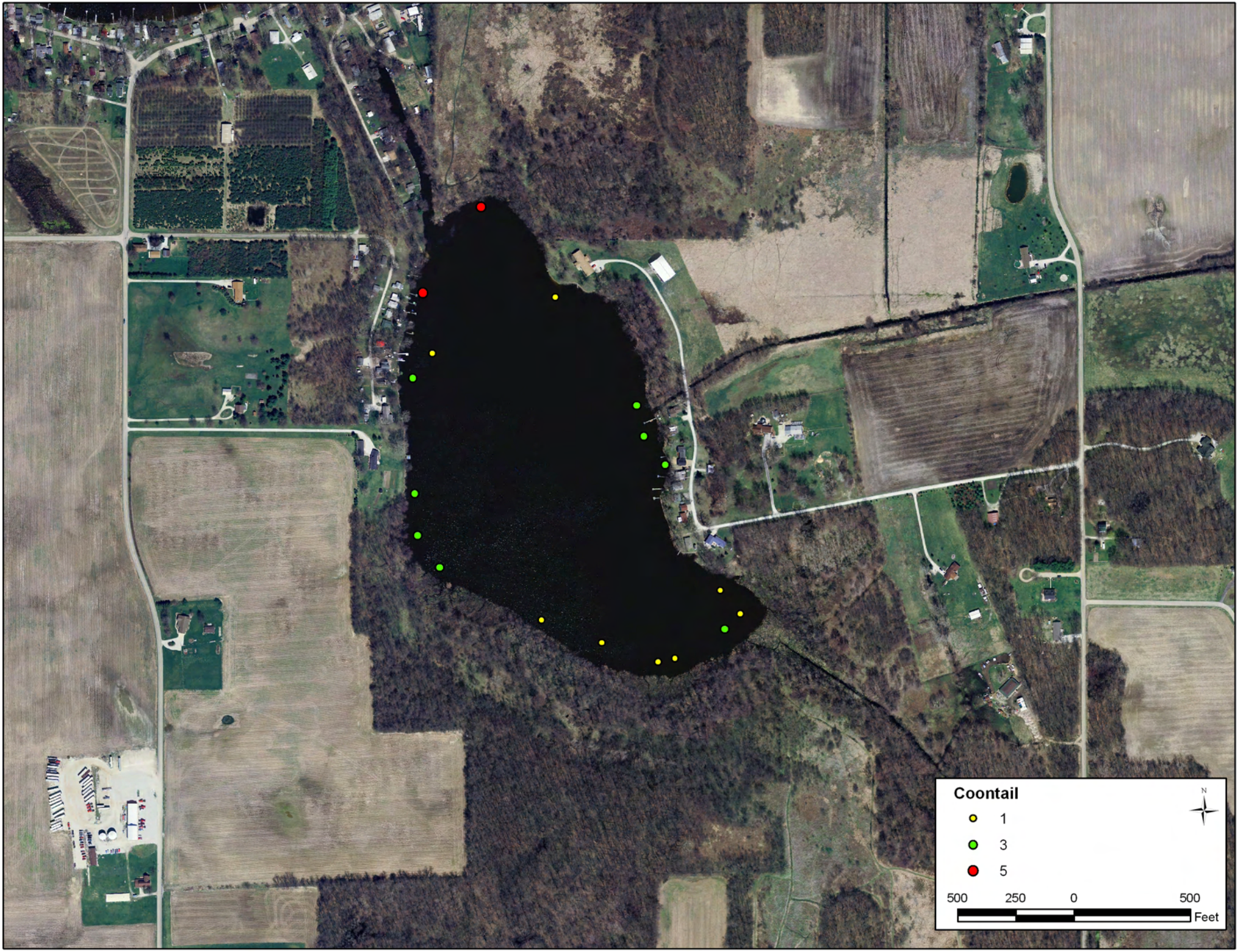
LAKE	DEPTH	FILALG	CERDEM	CHARA	MYREXA	MYRSPI	NAJGUA	POTBER	X_COOR	Y_COOR
Loon	7								586800.2209	4548480.543
Loon	4	p	3						586783.7937	4548583.093
Loon	12	p							586782.3529	4548535.834
Loon	3		3						586812.5824	4548545.911
Loon	5	p	3	1	1	1		1	586773.9909	4548622.829
Loon	11	p							586726.222	4548621.613
Loon	6	p							586740.7649	4548687.704
Loon	7	p							586714.3073	4548733.059
Loon	5	p	1						586665.051	4548763.693
Loon	10	p							586637.5403	4548798.959
Loon	11	p							586592.4077	4548841.928
Loon	10	p							586555.0534	4548841.441
Loon	3	p	5						586566.0394	4548879.933
Loon	9	p							586499.2353	4548790.105
Loon	5	p	5						586491.8796	4548766.686
Loon	5	p	3						586480.4379	4548654.385
Loon	7	p	1						586505.0334	4548687.452
Loon	8								586493.9531	4548628.601
Loon	5	p							586485.2917	4548540.062
Loon	9								586490.529	4548574.265
Loon	4	p	3						586485.289	4548503.145
Loon	5	p	3						586489.5287	4548448.532
Loon	5	p	3			1			586518.9453	4548407.009
Loon	5	p	1						586653.564	4548340.277
Loon	13	p							586606.0341	4548421.998
Loon	7	p	1						586732.5885	4548311.6
Loon	4	p	1				1		586806.8579	4548287.752
Loon	6	p	1						586829.2189	4548292.687
Loon	6	p	3						586893.763	4548331.616
Loon	5	p	1						586913.3509	4548352.402
Loon	6	p	1						586887.3471	4548382.343

APPENDIX B:

FIGURES

BEAVER DAM AND LOON LAKES
AQUATIC PLANT MANAGEMENT PLAN REVISION 2007
EXCERPT FROM YELLOW CREEK LAKES DIAGNOSTIC STUDY


Sago pondweed
1
3
5
500
250
0
500
Feet
N


Coontail
1
3
5
500
250
0
500
Feet
N